Texas Instruments

MSC1211

Precision Analog-to-Digital Converter

with 8051 Microcontroller and Flash Memory

Evaluation Module

User's Guide

April 2003

SBAU086

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During normal operation, some circuit components may have case temperatures greater than 60°C. The EVM is designed to operate properly with certain components above 60°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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Preface

Read This First

About This Manual

This users guide describes the function and operation of the MSC1211EVM. This manual will help you quickly set up the evaluation module and its accompanying software, so that you can rapidly test and evaluate the MSC1211. A complete circuit description, as well as schematic diagram and bill of materials, is included.

How to Use This Manual

This manual begins with an introductory chapter which describes the EVM and what it can do. If you're anxious to set things up and start testing, we suggest you read at least the first two chapters. These two chapters introduce you to the board and how to set it up to start working with it. Later chapters go into more detail on the board design and how to access its many features.

Information About Cautions and Warnings

This book may contain cautions and warnings.

This is an example of a caution statement.

A caution statement describes a situation that could potentially damage your software or equipment.

This is an example of a warning statement.

A warning statement describes a situation that could potentially cause harm to you.

The information in a caution or a warning is provided for your protection. Please read each caution and warning carefully.

Related Documentation From Texas Instruments

Data Sheets:	Literature Number:
MSC1211	SBAS267
REG1117–5.0,–3.3	SBVS001
ADS8325	SBAS226
MAX3243CPWR	SLLS350
TPS3837L30DBVT,TPS3838L30DBVT	SLVS292
SN74HC573ADW	SCLS147
SN74AC10PWR	SCAS529
SN74AHC1G08DBVR	SCLS3141
SN74AHC138PWR	SCLS2581

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Trademarks

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Chapter 1

Introduction

This chapter provides an overview of the MSC1211 evaluation module and software.

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1.1 MSC1211 Description

The MSC1211 is a precision 24-bit delta-sigma analog-to-digital converter (ADC) with an 8051 microcontroller, and up to 32K of flash memory. It has eight differential/single-ended analog inputs. The delta-sigma architecture employed in the MSC1211 enables the device to achieve 22 bits of effective resolution (0.45 ppm RMS noise) at a data rate of 10Hz. It can be programmed for other data rates up to 1kHz that have lower effective resolution. In addition to the standard 8051 peripherals and functions, the MSC1211 includes four 16-bit digital-to-analog converters (DACs), a 32-bit accumulator, a high-speed SPI or I^2C interface, a 16-bit PWM output, data flash memory, 1,280 bytes of data RAM, dual UARTS, and dual DPTR registers.

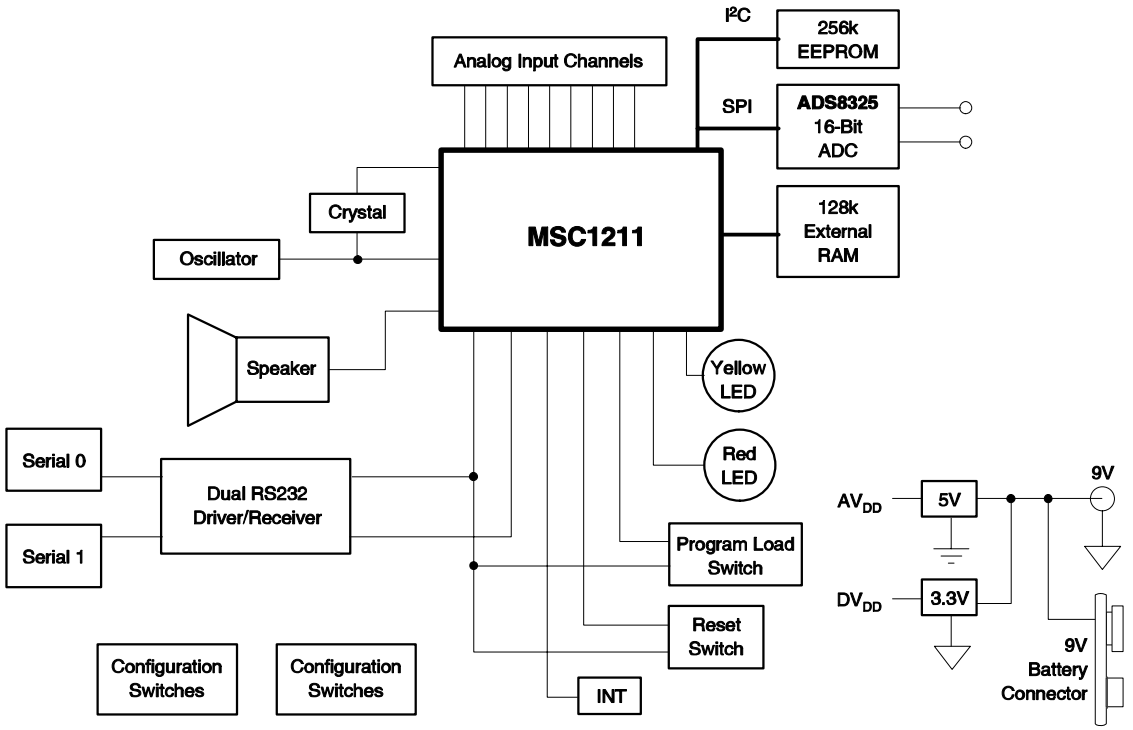
The MSC1211 has an enhanced 8051 core that only requires 4 clock cycles per machine cycle. It has extra timers, watchdog, brownout and low-voltage detect circuits, power management control and hardware breakpoint registers.

1.2 EVM System Overview

A block diagram of the MSC1211EVM is shown in Figure 1–1.

During normal operation, programs are developed on the PC and then downloaded into the MSC1211 for execution. The primary development environment is Raisonance for assembly and C language programming. There is also a BASIC–52 and a Basic interpreter available from MDL–Labs.

Figure 1–1. MSC1211EVM Block Diagram



1.3 Analog Inputs

Analog input is supplied through the ten–way screw terminal block, J4. The nine inputs are connected to the MSC1211 through a 100Ω resistor. There is also a terminal block for AGND. The inputs have the 100Ω resistors to provide minimal protection against overvoltage.

1.4 Prototyping Area

A prototyping area is provided on the MSC1211EVM. This may be used to incorporate additional circuitry, such as special reference or conditioning circuits, into the system. All of the signals on the MSC1211 are brought to connector pads. Additionally, there are digital and analog power and ground holes in the prototyping area.

1.5 Power Requirements

The MSC1211EVM must be supplied with 5.5V to 15V for proper operation. Power can be supplied through barrel jack J6 (tip positive), square pin connectors JMP5 (pins 2 and 3) and JMP6 (pins 2 and 3), or with a 9V battery connected to battery snap B1.

A 9V “wall–wart” power supply is included with the MSC1211EVM.

1.6 Host Computer Requirements

The Raisonance software development environment is designed to run on a PC running any Windows platform (Windows 95, 98, NT, 2000, etc).

Minimum Requirements:

- ❏ IBM-compatible 486 PC or higher
- ❏ Windows® 95/98/2000 or NT4.0
- ❏ 64MB RAM minimum
- ❏ 20MB available hard disk space
- ❏ CD-ROM drive
- ❏ Available serial port

Chapter 2

Getting Started

This chapter guides you through unpacking the MSC1211EVM and setting it up so you can begin working with it immediately.

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2.1 Unpacking the MSC1211EVM

After unpacking the MSC1211EVM kit, check to make sure you received all of the items listed here:

- ❑ MSC1211EVM board
- ❑ 9V “wall–wart” power supply
- ❑ 9-pin, D-sub, male-female serial cable
- ❑ This user’s guide
- ❑ Software CD-ROM

2.2 Default Configuration

Although much of the MSC1211EVM operation is controlled by the host PC, some configuration must be done directly on the board, using four jumpers (shorting blocks). The MSC1211EVM is configured at the factory, as shown in Table 2–1.

Table 2–1. Factory Jumper Settings

Jumper identifier	Description	Default Setting
JMP5	Analog power supply source	1–2
JMP6	Digital power supply source	1–2
J7	Internal Reference Select	1–2

For more information about the jumpers, see section 3.1.

2.3 Quick Start

Once the MSC1211EVM has been unpacked from its shipping container, and you have verified that the board is configured as shown in Table 2–1, it can be powered on and tested.

First, connect the board to the host PC using the supplied 9-pin serial cable. Then, power the board on by plugging the wall power adapter into a suitable ac power source and plugging the barrel plug into the barrel jack (J6) on the MSC1211EVM. (You do not have to connect the serial cable first; it is also acceptable to apply power to the board first.) When the board is properly powered on, the two green power-good indicator lamps near the power connectors will glow brightly.

Place the CD-ROM into your CD–ROM drive. Table 2–2 shows the directories located on the CD-ROM.

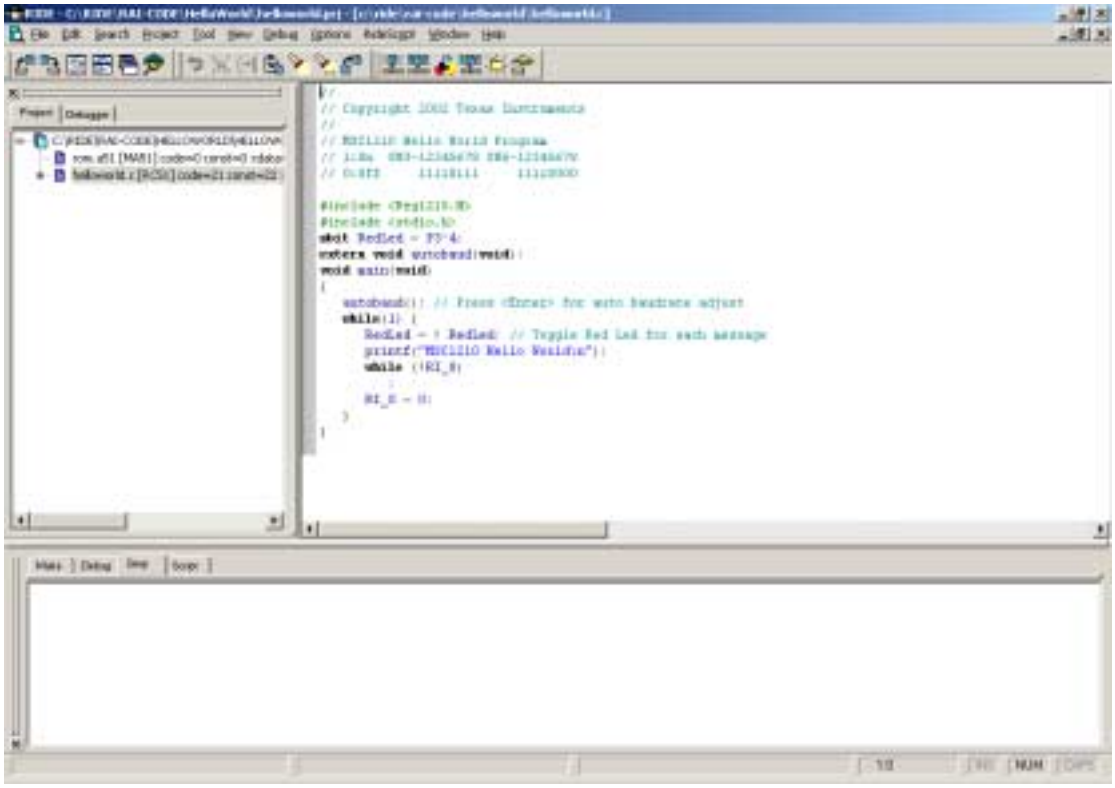
Table 2–2. CD-Rom Contents

Directory	Description
8051 Reference	Some reference documentation on the 8051
8051 Tutorial	An HTML tutorial from 8052.com
ADC Demo	A Visual demonstration of the operation of the MSC1211
Application Notes	Several Application notes for the MSC family
BASIC	BASIC–52 and MDL–BASIC
C Programming	Some information on C–Programming on 8051s
Downloader	Program for loading HEX files into the MSC Flash memory
EVMS	Design documents for the MSC EVMs
Example Programs	Various example programs for the MSC devices
Hitex ICE	An example of an external ICE which can be used with the MSC
MSC1210 Data Sheet	
MSC1210 User Manual	
Ride	Full featured C/Assembly development/simulator environment
Wickenhauser	A low cost C compiler for the MSC1210

Now, install two pieces of software on your PC: RIDE and the Download Tool. If you are running a Windows platform that is NT-based, such as Windows NT or Windows 2000, you will need administrator privileges to install the software. Follow the instructions that the installers give you.

Once the programs has been successfully installed, you can execute them. When the RIDE development system is run, it displays a splash screen, and then you will see something like the screen in Figure 2–1.

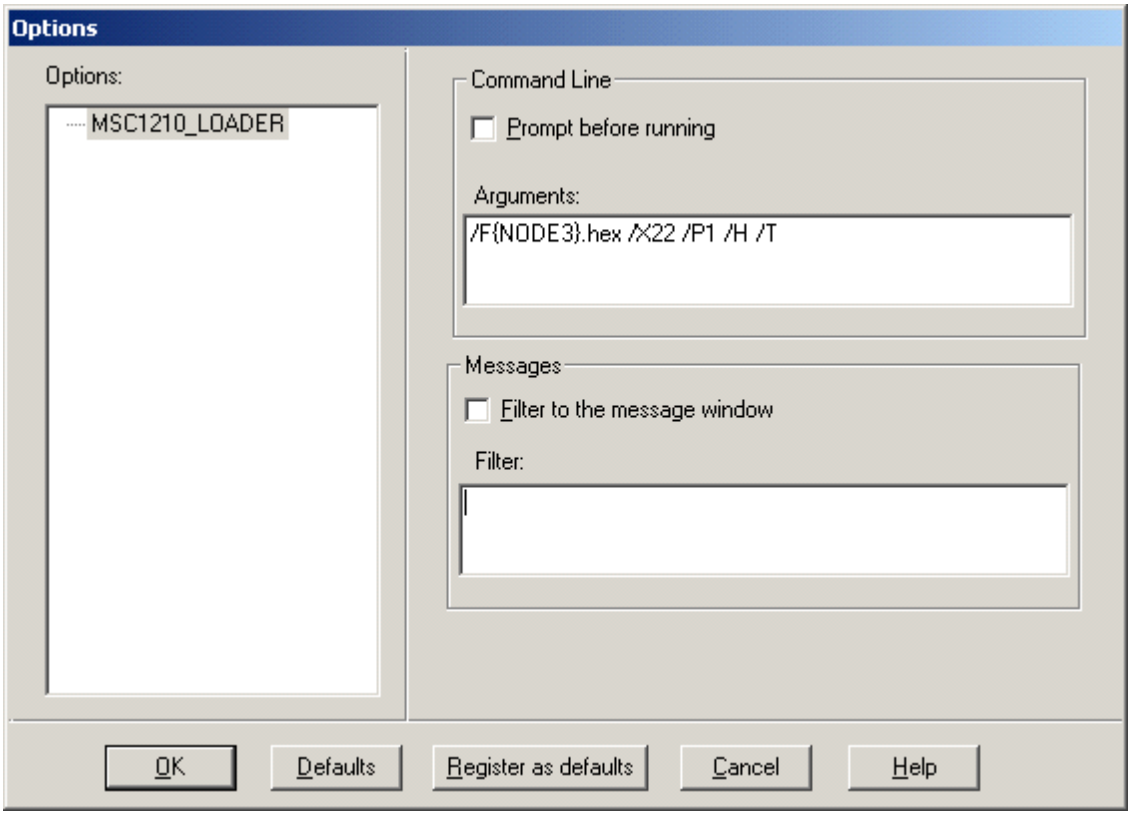
Figure 2–1. RIDE (Raisonance Integrated Development Environment)



Refer to the RIDE documentation and help menus for more information about how to interact with the RIDE environment. When a program is compiled, it can be immediately downloaded into the MSC1211EVM by using the MSC download utility program.

In the Project menu, select **Options** **Tools**, and then **Create** or **Edit** MSC1210_LOADER. Enter the path to the download.exe program that should be installed in your Windows directory. The download.exe file will need to be in the current directory or the Windows path. In the “translate from” and the “translate to” windows add “*.aof”. Select Advanced and you will have see the screen shown in Figure 2–2.

Figure 2–2. Tool Advanced Options



UnCheck the Prompt before running box.

All operands should immediately follow the switch character with no spaces except between options. i.e.:

/F{NODE3}.hex /X22 /P1 /H /T

If the filename, crystal frequency, or port are not included, a screen will prompt for the values. The operand list is defined in Table 2–3.

Table 2–3. Downloader Operand Definitions

Operand	Definition
/Ffile	hex file, {NODE3} in the RIDE will substitute the hex file (required)
/Xfreq	MSC1211 Xtal Clock frequency (required)
/Pport	PC Comm port 1, 2, 3 or 4 (required)
/Bbaud	Baud rate (standard rates), otherwise it is computed from /Xfreq
/H	If this flag is present the configuration bytes will be erased
/T	This flag requests a terminal window after download.

Chapter 3

Operation

This chapter describes each function of the MSC1211EVM, and how to use the accompanying software to program and use the MSC1211.

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3.1 Jumpers

Table 3–1 shows the function of each jumper on the EVM.

Table 3–1. Jumper/Function Reference

Reference Designator	Setting/Pin	Function	Default	Subsection
JMP1	1 to 2	Short R1 for IDAC0 output	Disconnected	3.1.1
JMP2	1 to 2	Short R2 for IDAC1 output	Disconnected	3.1.2
JMP3	1 to 2	Connect I^2C SDA signal	Disconnected	3.1.3
JMP4	1 to 2	Connect I^2C SCL signal	Disconnected	3.1.4
JMP5	1 to 2	Onboard AV_{DD}	1–2	3.1.5
	2 to 3	External AV_{DD}		
JMP6	1 to 2	Onboard DV_{DD}	1–2	3.1.6
	2 to 3	External DV_{DD}		
J7	1	AGND	1–2	3.1.7
	2	REF IN–		
	3	VDAC1		
	4	REF IN+/REFOUT		
	5	Open		
	6	AV_{DD}		
J16	1	Memory A14	RAM 1–3, 2–4, 5–6	3.1.8
	2	MSC1211 A15		
	3	MSC1211 A14		
	4	Memory A15		
	5	Memory /WE		
	6	MSC1211 /WE		

3.1.1 JMP1: Short R1

In order to allow current output IDAC0 to have full compliance, JMP1 can be used to short out resistor R1, which is in series with that signal.

3.1.2 JMP2: Short R2

In order to allow current output IDAC0 to have full compliance, JMP2 can be used to short out resistor R2, which is in series with that signal.

3.1.3 JMP3: I^2C Data SDA Enable

The MSC1211 uses the same signals for SPI and I^2C. Since there is no chip select available for the I^2C device, this jumper will allow the isolation of the 256K EEPROM during SPI testing.

3.1.4 JMP3: I^2C Data SCL Enable

The MSC1211 uses the same signals for SPI and I^2C. Since there is no chip select available for the I^2C device, this jumper will allow the isolation of the 256K EEPROM during SPI testing.

3.1.5 JMP5: AV_{DD} Power Source Select

The MSC1211 has separate analog and digital power supplies. Use JMP5 to connect the desired voltage source for the analog power supply AV_{DD}. Shorting pins 1 and 2 connects the onboard 5V regulator. Pins 2–3 can be used to supply an external voltage for use as $AV_{DD;}$ pin 2 is for the external voltage and pin 3 is for AGND.

3.1.6 JMP6: DV_{DD} Power Source Select

The MSC1211 has separate analog and digital power supplies. Use JMP6 to connect the desired voltage source for the digital power supply DV_{DD}. Shorting pins 1 and 2 connects the onboard 5V regulator. Pins 2–3 can be used to supply an external voltage for use as $DV_{DD;}$ pin 2 is for the external voltage and pin 3 is for AGND.

3.1.7 J7: Reference Select

J7 has six pins. For normal operation pins 1 and 2 are connected for REF IN– to be connected to AGND. Since the MSC1210 has a very similar pinout to the MSC1210, the MSC1211 board is designed to accommodate the MSC1210 device. For the MSC1210, the VDAC1 pin is the REFOUT pin. Therefore, a connection between pins 3 and 4 will provide the other required connection for use of the internal reference for the MSC1210. Only pins 1 and 2 are needed for the MSC1211. Pins 4 and 6 can be connected together, if you want to use AV_{DD} as the reference voltage.

3.1.8 J16: Memory Configuration

The MSC1211EVM can use either RAM or EEPROM in the socket for U9. The J16 jumper provides the capability to configure the Addressing and Write Enable signals for each use. For use with compatible EEPROMs, the following pins are shorted: 1–2, 3–5 and 4–6. For use with the RAM memory that comes standard on the MSC1211EVM, the following pins are shorted: 1–3, 2–4, 5–6.

3.2 Switches

3.2.1 RESET Switch

Switch SW1 is a miniature pushbutton that, when pressed, forces the MSC1211 RST line high. When released, the MSC1211 enters a reset cycle. If communication becomes disrupted between the host and the board, or the board is unresponsive, pressing RESET will return the system to normal operation.

3.2.2 INT Switch

Switch SW2 is a miniature pushbutton that, when pressed, shorts Port 3.2 to ground. This pin is the $\overline{\text{INT0}}$ pin and, therefore, can be setup to cause an interrupt when this pin goes low.

3.2.3 SW3: Configuration Switch

SW3 provides the means to enable or disable many of the function on the MSC1211EVM.

Table 3–2. SW3: Configuration Control Switch

Switch Number	Function
1	Enables pin P3.5 to control the Yellow LED D5
2	Enables pin P3.4 to control the Red LED D4.
3	Enables pin P3.3 to drive the speaker.
4	Enables pin P3.0 to receive data from Serial0 (J5)
5	Disables on–board 22.1184MHz crystal oscillator
6	Enables pin P1.2 to receive data from Serial1 (J4)
7	Allows DTR from Serial0 to reset MSC1211
8	Allows RTS from Serial0 to reset to Prog Load mode

3.2.4 PRG LD Switch

SW4 is a miniature pushbutton that, when pressed, forces the MSC1211 RST line high. It also pulls the $\overline{\text{PSEN}}$ line low so that when released, the MCU will enter a reset cycle in the Program Load mode. Program execution will be from the on-chip ROM, and it starts by waiting for a carriage return so that it can perform an autobaud function.

3.2.5 SW5: Emulation and Control Switch

SW5 provides the means to break several signals so that they can be controlled by an emulator plugged into J14. This switch also provides a means of setting the operating mode of the MSC1211.

Table 3–3. SW5: Configuration Control Switch

Switch number	Function
1	Enables the /RD signal or breaks for emulator use.
2	Enables the /WR signal or breaks for emulator use.
3	Enables the Reset signal or breaks for emulator use.
4	Enables the PSEN signal or breaks for emulator use.
5	Provides a method to pull PSEN low.
6	Enables banks switching of 128K RAM memory
7	Provides a method to pull ALE low.
8	Connects EA to DGND

3.3 I/O Connectors and Signals

The various connectors on the MSC1211EVM are described in this section.

3.3.1 J8: Serial0 RS-232 Connector

The host PC communicates with the MSC1211EVM through this connector, which is a D-shell type, 9-pin female, pinned out in the usual manner. Some of the flow control lines are used for special purposes by the MSC1211EVM board; these are described in Table 3–4.

In the RS-232 electrical specification, –5V to –15V on a line indicates a logic high (mark), and +5V to +15V indicates logic low (space). Line states are described here according to their logical states.

If a non-handshaking RS-232 cable is used (i.e., one that connects only RD, TD, and signal ground), the board can still operate normally, but it cannot be reset by the host PC, and bootstrap firmware upgrading cannot be performed through the serial port.

Table 3–4. J8: RS-232 Port Pinout

Pin Number	Signal Name	RS-232 Name	Direction (at board)	Function
1	DCD	Data Carrier Detect	Output	None
2	RD	Receive Data	Output	Serial data output to the host PC
3	TD	Transmit Data	Input	Serial data input from the host PC
4	DTR	Data Terminal Ready	Input	Connected to the reset circuit. A low-to-high transition on this line resets the MCU.
5	SG	Signal Ground	Power	Ground reference
6	DSR	Data Set Ready	Output	None
7	RTS	Request To Send	Input	Connected to PROG LOAD function. Used to enter serial programming mode. A high-to-low transition resets the MCU and puts it into serial programming mode.
8	CTS	Clear To Send	Output	None
9	RI	Ring Indicator	Output	None

3.3.2 J9: Serial1 RS-232 Connector

This connector is available for use with the second UART in the MSC1211. Only the TD and RD lines are used. The DTR pin is connected to the DSR pin, and the RTS pin is connected to the CTS pin.

In the RS-232 electrical specification, –5V to –15V on a line indicates a logic high (mark), and +5V to +15V indicates logic low (space). Line states are described here according to their logical states.

Signal descriptions are described in Table 3–5.

Table 3–5. J8: RS-232 Port Pinout

Pin Number	Signal Name	RS-232 Name	Direction (at board)	Function
1	DCD	Data Carrier Detect	Output	None
2	RD	Receive Data	Output	Serial data output to the host PC
3	TD	Transmit Data	Input	Serial data input from the host PC
4	DTR	Data Terminal Ready	Input	Connected to DSR
5	SG	Signal Ground	Power	Ground reference
6	DSR	Data Set Ready	Output	Connected to DTR
7	RTS	Request To Send	Input	Connected to CTS
8	CTS	Clear To Send	Output	Connected to RTS
9	RI	Ring Indicator	Output	None

3.3.3 J6, JMP5, JMP6, B1: Power Connectors

The MSC1211EVM features a flexible power supply. Externally generated power, the onboard regulator circuitry and supplied wall-wart, or a 9V battery can all be used to supply power. Furthermore, the separated analog and digital power supplies can be powered differently; e.g., the analog power supply can be powered externally, and the digital power supply can use the onboard regulator, at the same time; this is configured using jumpers JMP5 and JMP6. The exception to this is that the battery and wall–wart cannot be used at the same time (see following paragraph).

Four power connectors are provided: JMP5 (pins 2–3) and JMP6 (pins 2–3) for external power, battery terminal B1 for a 9V transistor radio battery, and J6 for the supplied wall-wart. J6 is a switched jack—connecting a plug to J6 automatically disconnects the battery terminal. This prevents the battery and J6 from supplying power simultaneously.

Battery power is regulated by the same circuitry that regulates J6 (wall–wart) power. Note that when a battery is connected to B1, approximately one half of the prototyping area is covered up by the battery.

Caution: Be *very* careful when connecting external power supplies to JMP5 (pins 2 and 3) and JMP6 (pins 2 and 3). They are not protected against reversed polarity. If you connect them backwards (i.e., with reversed polarity), it is likely that the MSC1211EVM will be permanently damaged.

Table 3–6. Unregulated Power Input Connector

Terminal name	Function
Tip	Positive power supply input
Sleeve	Power ground

Table 3–7. B1: 9V Battery Connector

Terminal name	Function
Split (female) ring	Positive (mates with solid/male post on battery)
Solid (male) ring	Negative (mates with split/female post on battery)

3.3.4 J4: Analog Inputs

Terminal block J4 is the main analog input to the MSC1211EVM, as is defined in Table 3–8. One terminal is provided for each of the nine MSC1211 differential inputs. Each terminal is connected to the MSC1211 through a 1kΩ resistor.

Table 3–8. J4: Analog Inputs

Terminal Number	Terminal Name	MSC1211 Pin Number	Function
1	AN0	18	Analog Input 0
2	AN1	19	Analog Input 1
3	AN2	20	Analog Input 2
4	AN3	21	Analog Input 3
5	AN4	22	Analog Input 4
6	AN5	23	Analog Input 5
7	AN6/EXTD	24	Analog Input 6 and Digital Low Voltage Detect
8	AN7/EXTA	25	Analog Input 7 and Analog Low Voltage Detect
9	AINCOM	26	Analog Common
10	AGND	17, 27	Analog Ground

3.3.5 J7: External Reference Input

The MSC1211EVM has an onboard 2.5V/1.25V bandgap reference. If a lower-noise reference source or a reference with a different voltage is desired, it can be connected to square pin connector J7. The reference source (onboard or external) is selected using pins 1 and 2 of J7. Bypassing for the reference inputs is provided by C17 and C18. To use the internal REFOUT signal, connect pins 1 and 2 together.

Table 3–9. J7: External Reference Input

Terminal Number	Function
1	AGND—Analog Ground
2	REF IN–
3	VDAC1/(REF+ for MSC1211)
4	REF IN+/REFOUT
5	Open
6	AV_{DD}

3.3.6 TP1–6: Test Points

The test points can be used to monitor certain signals on the board.

For information on the signals connected directly to the MSC1211, consult the MSC1211 datasheet (SBAS267) located at www.ti.com.

Table 3–10. TP1–6: Test Points

Test Point Designator	MSC1211 Pin Number	MSC1211 Pin Name	Signal Description
TP1	—	—	GND
TP3	6	P3.3/$\overline{\text{INT1}}$/PWM	PWM output connected to the speaker
TP4	—	—	RTS on Serial0
TP5	—	—	DTR on Serial0
TP6	—	—	RX on Serial0
TP7	—	—	TX on Serial0
TP8	13	RST	Reset signal to the MSC1211
TP9	44	$\overline{\text{PSEN}}$	Program Select Enable from MSC1211
TP10	—	—	A0
TP11	—	—	A1
TP12	—	—	A2
TP13	—	—	A3
TP14	—	—	A4
TP15	—	—	A5
TP16	—	—	A6
TP17	—	—	A7
TP18	48	$\overline{\text{EA}}$	External Memory Enable
TP19	45	ALE	Address Latch Enable

3.4 Circuit Descriptions

The MSC1211EVM combines the MSC1211 microcontroller, 128K RAM, the ADS8325, 256K EEPROM, a 22.1184MHz crystal, support for two serial ports, and other support circuits to aid in the evaluation of the MSC1211.

3.4.1 MSC1211

The MSC1211 (U5) is clocked by the 22.1184MHz crystal oscillator, unless it is disabled with switch SW3–6. When the oscillator is disabled, the MSC1211 can use crystal X1 to provide the clock source using on–chip circuitry, although oscillator X2 must be removed from the board for reliable crystal operation. Inputs come from J4 through current-limiting resistors R1–R9.

Programs can be loaded into the 32K bytes of flash memory using the serial port (Serial0). The MSC1211 has 1,380 bytes of on–chip RAM. Extra RAM is available through the use of the 128K RAM (U9). 64K of RAM is directly addressable, with P1.4 providing the means for bank switching.

For detailed information about the MSC1211, consult the MSC1211 product datasheet (SBAS267) located at www.ti.com.

3.4.2 Programming and Host Communication

The Raisonance integrated software environment (RIDE) and the TI Downloader program make for a convenient system of program development, download, and execution.

Full source code for the MSC1211EVM firmware is included on the CD-ROM.

3.4.3 Power Supply

Power is brought into the board through external power connectors JMP5 (pins 2 and 3) and JMP6 (pins 2 and 3), battery connector B1, or unregulated power input J6. If a wall power adaptor is plugged into J6, the battery is disconnected.

Power supplied from the battery or through J6 is regulated by voltage regulators U3, and U4, which provide +5V digital and +5V analog supplies. Power supplied from the external connectors (JMP5 and JMP6) is not filtered; regulated power of the correct voltages must be supplied to these connectors.

The board is laid out with separate analog and digital power supplies. Analog power is 5V and is supplied from regulator U3, or external power connector JMP5. 5V digital power is supplied from regulator U4 or JMP6. When the external power connector J6 is used, it supplies regulator U3 and U4.

Chapter 4

Physical Description

This chapter contains the schematic drawings and PCB layouts for the MSC1211EVM board.

Topic **Page**

4.1 Schematics

Figure 4–1. Processor Schematic

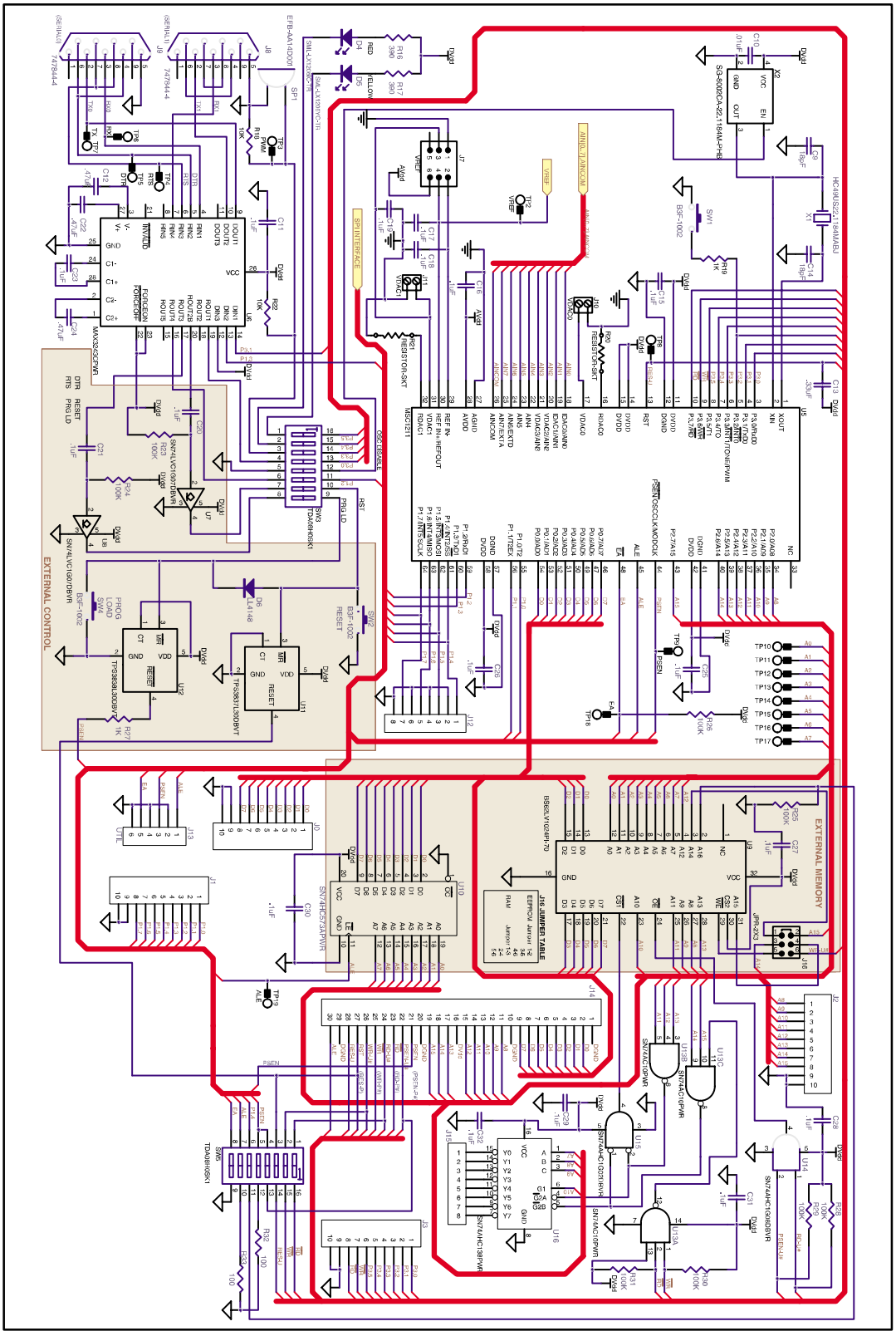
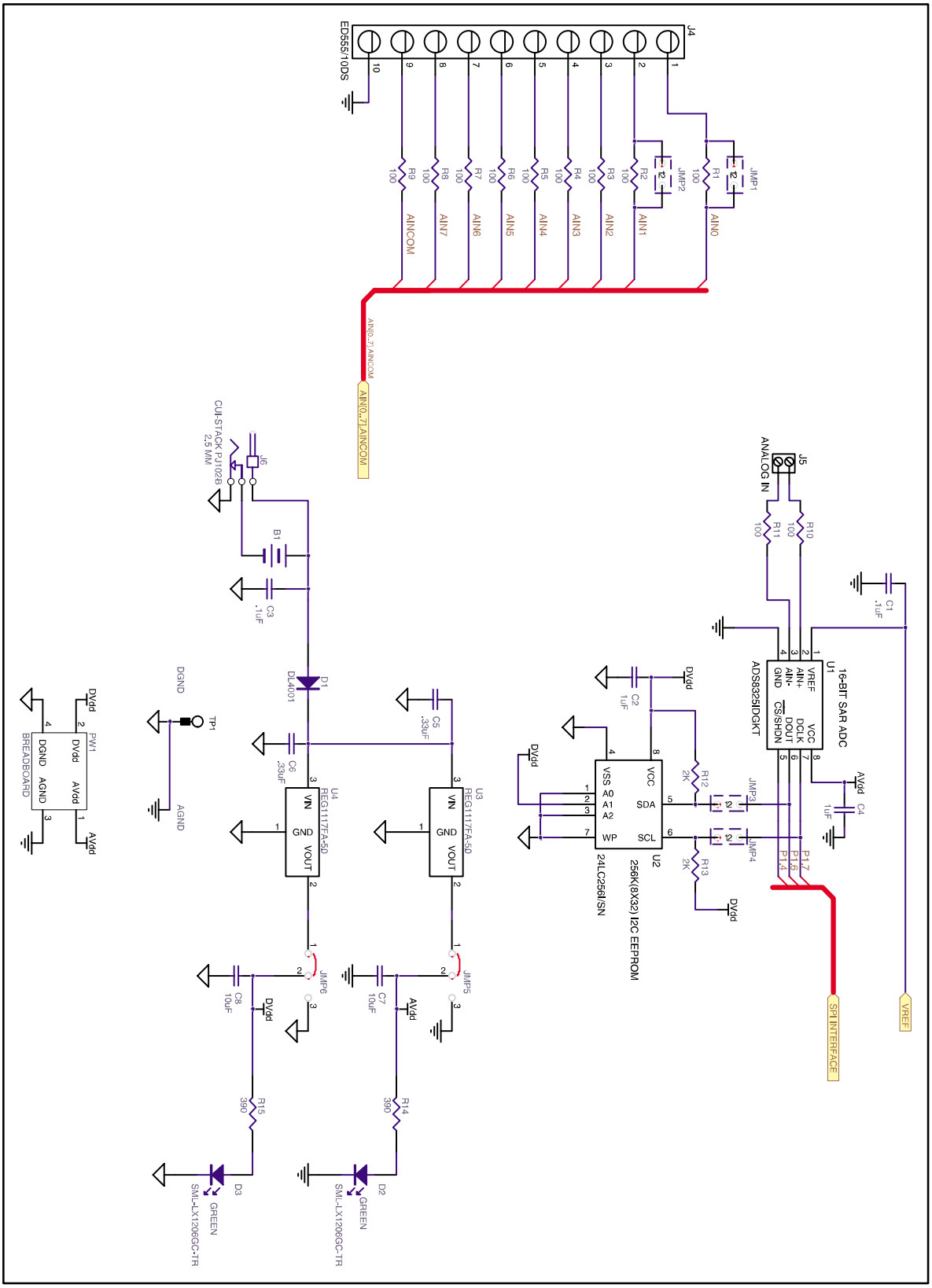
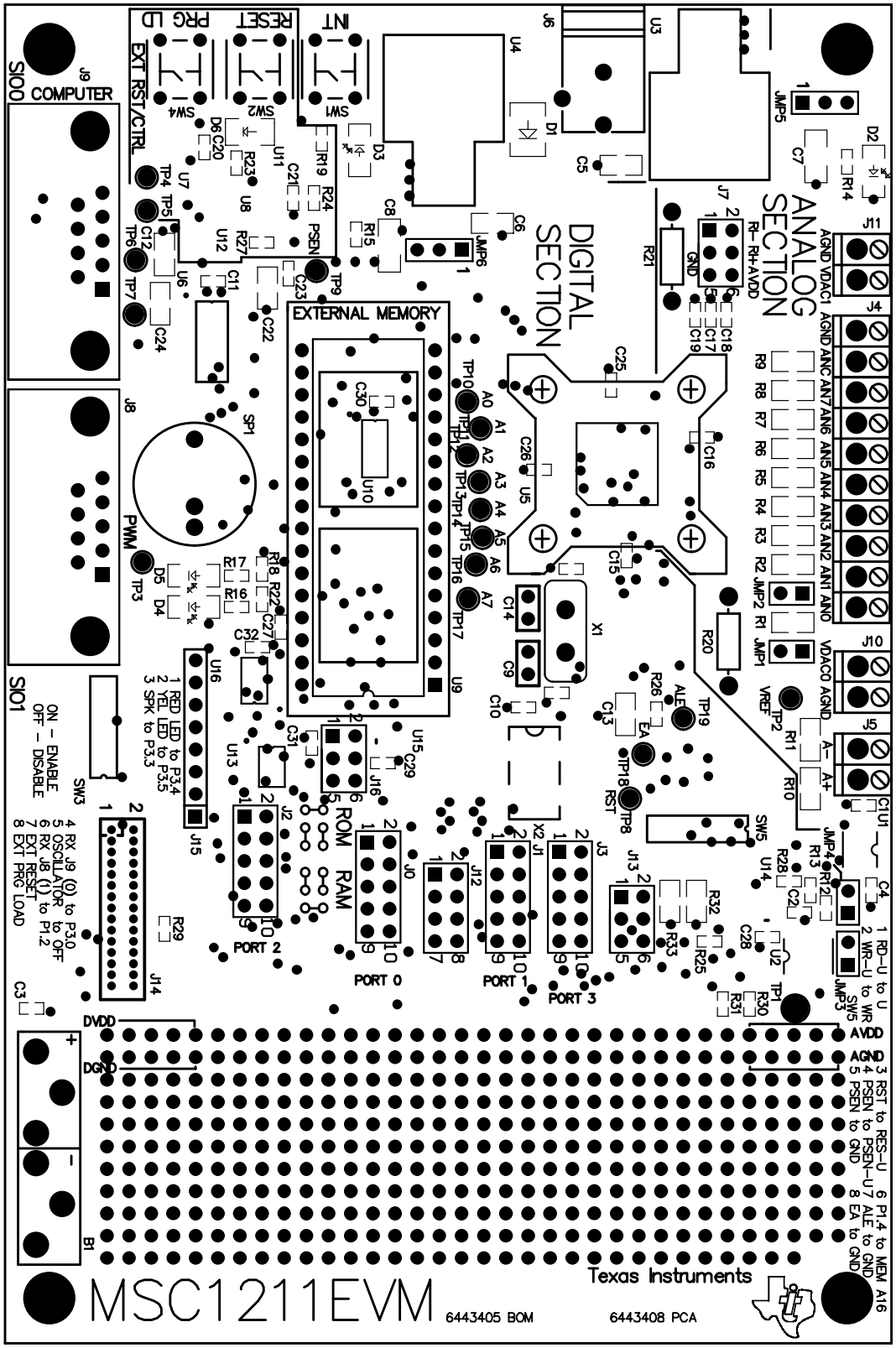


Figure 4–2. Power and Analog Inputs Schematic



4.2 Component Locations

Figure 4–3. Printed Circuit Board Layout



4.3 Power-Supply CE Certification

FRIWO Gerätebau GmbH
Von-Liebig-Str. 11
D-48346 Ostbevern
Germany

FRIWO

CE-Konformitätserklärung
Declaration of Conformity

Wir, der Hersteller, erklären hiermit, daß das Produkt:
We, the manufacturer, hereby confirm, that the product:

Typ: *Type:* **FW 7207/9**

Zeichnungs-Nr.: *Part-No.:* **15.0661.500-00**

weitere Merkmale:
additional information:

mit der beiliegenden Beschreibung die Anforderungen der Niederspannungsrichtlinie 73/23/EWG, CE-Kennzeichnungsrichtlinie 93/68/EWG und der EMV-Richtlinien 89/336/EWG, 92/31/EWG erfüllt.
with the enclosed description fulfills the requirements of the Low Voltage Directive 73/23/EEC, CE Marking Standard 93/68/EEC and the regulations of the EMC Directives 89/336/EEC, 92/31/EEC.

Das Gerät entspricht der:
The unit corresponds to:

a) Niederspannungsrichtlinie
Low Voltage Directive

- ☐ **EN 60742 9/95**
- ☐ EN 60335 5/95
- ☒ EN 60950 9/94
- ☐ EN 60601 9/94

b) EMV-Richtlinie
EMC-Directive

- ☒ EN 50081-1 3/93
- ☐ EN 50081-2 3/94
- ☐ EN 50082-1 3/93
- ☒ EN 50082-2 2/96

Ausstelldatum:
Date of Issue: 98-10-02

Quality Manager ppa. Busche

R & D Manager i.V. Dr. Ebert

FRIWO Gerätebau GmbH
Von-Liebig-Straße 11
48346 Ostbevern

Firmenstempel Company stamp

checked: R & D Electr. Man. i. V. Schulz

4.4 Bill of Materials

Table 4–1. Bill of Materials

Item No.	Quantity	Value	Designator	Description	Vendor	Part Number
1	13	100Ω	R1–R11, R32, R33	1/10W 5% chip resistor	Panasonic	ERJ–6GEYJ101V
2	4	390Ω	R14–R17	1/16W 5% chip resistor	Panasonic	ERJ–3GEYJ391V
3	2	1kΩ	R19, R27	1/16W 5% chip resistor	Panasonic	ERJ–3GEYJ102V
4	2	2kΩ	R12, R13	1/16W 5% chip resistor	Panasonic	ERJ–3GEYJ202V
5	2	10kΩ	R18, R22	1/16W 5% chip resistor	Panasonic	ERJ–3GEYJ103V
6	8	100kΩ	R23–R26, R28–R31	1/16W 5% chip resistor	Panasonic	ERJ–3GEYJ104
Not installed	2		R20, R21			
7	2	18pF	C9, C14	50V ceramic chip capacitor, ±5%, NPO	Panasonic	ECJ–1VC1H180J
8	1	10000pF	C10	16V ceramic chip capacitor, ±10%, X7R	Panasonic	ECJ–1VB1C103K
9	19	0.1µF	C1, C3, C11, C15–C21, C23, C25–C32	16V ceramic chip capacitor, ±10%, X7R	Panasonic	ECJ–1VB1C104K
10	3	0.33µF	C5, C6, C13	16V ceramic chip capacitor, ±10%, X7R	Panasonic	ECJ–2YB1C334K
11	3	0.47µF	C12, C22, C24	16V ceramic chip capacitor, ±10%, X7R	Panasonic	ECJ–2YB1C474K
12	2	1µF	C2, C4	6.3V ceramic chip capacitor, ±10%, X5R	Panasonic	ECJ–1VB0J105K
13	2	10µF	C7, C8	6.3V ceramic chip capacitor, ±10%, X5R	Panasonic	ECJ–3YB0J106K
14	1		D1	Diode 1A 50V SMD MELF	Micro Commercial Components	DL4001
15	2		D2, D3	LED green clear lens 1206 SMD	Lumex	SML–LX1206GC–TR
16	1		D4	LED red clear lens 1206 SMD	Lumex	SML–LX1206IC–TR
17	1		D5	LED yellow clear lens 1206 SMD	Lumex	SML–LX1205YC–TR
18	1		D6	Diode fast switching SMD miniMELF	Diodes Incorporated	LL4148

(continued on next page)

Table 4–1. Bill of Materials (continued)

Item No.	Quantity	Value	Designator	Description	Vendor	Part Number
19	1		SP1	Piezoelectric ceramic buzzer	Panasonic	EFB–AA14D001
20	1		X1	22.1184MHz quartz crystal thru-hole	Citizen	HC49US22.11840592MABJ
Not installed	1		X2	5V 22.1184MHz programmable oscillator SMD	Epson	SG–8002CA–22.1184M–PHB
21	1		U1	16-bit SAR analog-to-digital converter (ADC)	Texas Instruments	ADS8325IBDGKT
22	1		U2	256K I^2C CMOS serial EEPROM	MicroChip	24LC256I/SN
23	2		U3, U4	+5V 1A low-dropout voltage regulator	Texas Instruments	REG1117FA–5.0
24	1		U5	24-bit 8-channel intelligent ADC	Texas Instruments	MSC1211
25	1		U6	Multi-channel RS-232 line driver/receiver	Texas Instruments	MAX3243CPWR
26	2		U7, U8	Single IC buffer driver with open drain o/p	Texas Instruments	SN74LVC1G07DBVR
27	1		U9	128K x 8-bit CMOS SRAM	Brilliance Semiconductor	BS62LV1024PI–70
28	1		U10	Octal D-type latches with 3-state outputs	Texas Instruments	SN74HC573APWR
29	1		U11	Supervisory circuit active high reset	Texas Instruments	TPS3837L30DBVT
30	1		U12	Supervisory circuit active low open drain	Texas Instruments	TPS3838L30DBVT
31	1		U13	Triple 3-input NAND gates	Texas Instruments	SN74AC10PWR
32	1		U14	Single 2-input NAND gate	Texas Instruments	SN74AHC1G08DBVR
33	1		U15	Single 2-input positive NOR gate	Texas Instruments	SN74AHC1G02DBVR
34	1		U16	3-line to 8-line decoder/demultiplexer	Texas Instruments	SN74AHC138PWR
35	1		N/A	MSC1211EVM PWB	Texas Instruments	6443406
36	1		B1 (+)	9V battery clip female	Keystone Electronics	594
37	1		B1 (–)	9V battery clip male	Keystone Electronics	593
38	2		J8, J9	DB9 right angle female conn. w/board locks	Tyco/AMP	747844–4
39	1		J6	2.5mm power connector	CUI Stack	PJ–102B

(continued on next page)

Table 4–1. Bill of Materials (continued)

Item No.	Quantity	Value	Designator	Description	Vendor	Part Number
Not installed	2		J14	1 x 15 single row socket .050″ spacing	Mill-Max	851–93–050–10–001 (15)
Not installed	1		J15	1 x 8 header, 0.1″ spacing	Samtec	TSW–108–07–L–D
40	3		J5, J10, J11	2 contact screw terminal block, 3.5mm	On Shore Technology	ED555/2DS
41	1		J4	10 contact screw terminal block, 3.5mm	On Shore Technology	ED555/10DS
Not installed	1		J13	2 x 3 header, 0.1″ spacing	Samtec	TSW–103–07–L–D
42	2		J7, J16	2 x 3 header, 0.1″ spacing	Samtec	TSW–103–07–L–D
Not installed	1		J12	2 x 4 header, 0.1″ spacing	Samtec	TSW–104–07–L–D
Not installed	4		J0, J1, J2, J3	2 x 5 header, 0.1″ spacing	Samtec	TSW–105–07–L–D
43	4		JMP1–JMP4	2-position jumper, 0.1″ spacing	Samtec	TSW–102–07–L–S
44	2		JMP5, JMP6	3-position jumper, 0.1″ spacing	Samtec	TSW–103–07–L–S
45	3		SW1, SW2, SW4	Momentary pushbutton tact switch	Omron	B3F–1002
46	2		SW3, SW5	8-pos DIP switch, half pitch SMD	C&K Components, Inc.	TDA08H0SK1
47	1		TP1	Large loop test point switch	Keystone Electronics	5011
48	18		TP2–TP19	Miniature test point terminal	Keystone Electronics	5000
49	6		R20, R21, X1	Miniature spring socket	Tyco/AMP	50863–5
50	11		N/A	Shorting jumper	Samtec	SNT–100–BK–TH
51	4		N/A	1/4″ x .625 hex 4-40 threaded standoff	Keystone Electronics	1808
52	4		N/A	Pan head machine screws 4-40 x 1/2″ phillips	Building Fasteners	PMS 440 0050 PH
53	1		U9	32-pin low profile, open frame DIP socket	Mill-Max	115–93–632–41–003